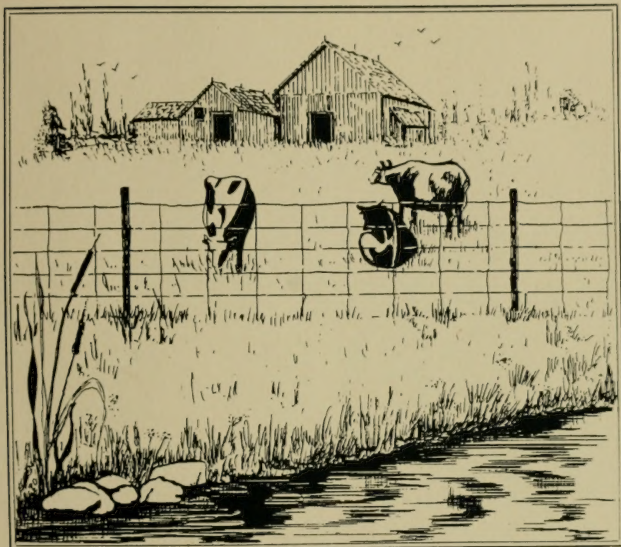


CLEAN UP RURAL BEACHES (CURB) PLAN

FOR THE PEPPERLAW BROOK
DRAINAGE BASIN



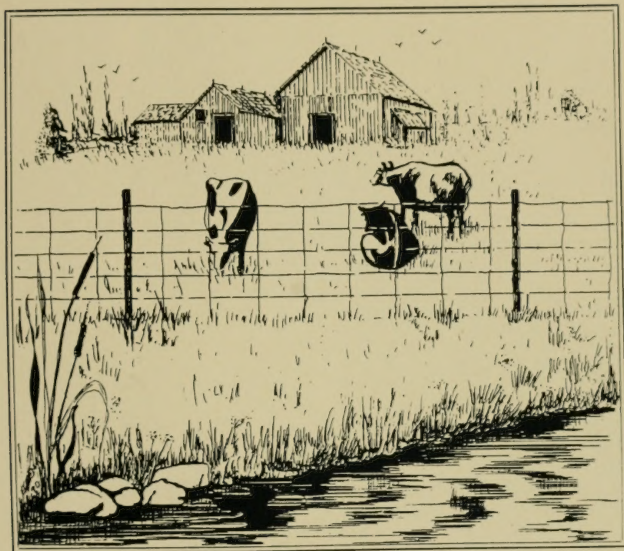
PRODUCED BY
THE LAKE SIMCOE REGION
CONSERVATION AUTHORITY

FOR THE ONTARIO MINISTRY OF THE ENVIRONMENT

ISBN 0-7729-8654-1

CLEAN UP RURAL BEACHES (CURB) PLAN

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DISCLAIMER

This report has been reviewed by the local Technical Steering Committee and approved for publication. Approval does not necessarily signify that the contents reflect the position and/or policies of individual agencies.

FOREWORD

This report is one of a series produced under the Provincial Rural Beaches Program. The objective of the Program is to identify the relative impact of pollution sources, and develop a course of action leading to the restoration and long term maintenance of acceptable water quality at provincial rural beaches.

Significant enrichment and bacterial contamination in southern Ontario rivers and lakes originates from rural sources. The discharge of waste material to streams can result in elevated bacterial concentrations, nuisance algae blooms, fish kills, and present a potential health hazard to humans and livestock using the water. Watershed studies have found that a multitude of pollution sources and pathways may affect beaches in Ontario. These include:

- 1) Urban sanitary and stormwater runoff,
- 2) Direct livestock manure access to watercourses,
- 3) Inadequate manure management practices,
- 4) Direct discharge of milkhouse wastes,
- 5) Contaminated field tile systems, and
- 6) Faulty septic systems

The impact upon beaches of any of these sources, either singly or in combination, can range from a few days of elevated concentrations to complete seasonal closures.

Numerous beach closings in 1983 and 1984, drew public and government attention to the severity of this water quality problem. In 1985, the Ontario Ministry of the Environment's (MOE) Water Resources Branch formulated the Provincial Rural Beaches Strategy Program. Directed by the Provincial Rural Beaches Planning and Advisory Committee, it includes representatives from MOE, Ministry of Agriculture and Food (OMAF), and Ministry of Natural Resources (MNR).

With financial and technical assistance from the MOE, local Conservation Authorities carry out studies under the direction of a local technical steering committee. Chaired by an MOE regional staff, the committees typically include representation from OMAF, MNR, the Medical Officer of Health, Conservation Authority, the local Federation of Agriculture, and a local farmer. The chairs of the local committees assure communication between all the projects by participating on the Provincial Committee.

The primary objective of each local study is to identify the relative impact of pollution sources, their pathways to beaches, and to develop a Clean Up Rural Beaches (CURB) plan specific to the watershed upstream of each beach. The CURB plan develops remedial strategy options and respective cost estimates for each beach through:

- 1) Field inspections,
- 2) Farmer consultations,
- 3) Water quality monitoring, and
- 4) Basic mathematical modelling techniques.

Recommended actions will include both measures for specific beaches and broader scale Provincial measures based on cumulative results of component studies.

The following related research projects were also MOE funded and undertaken by various Conservation Authorities to improve our understanding of bacterial and nutrient dynamics:

- 1) Insitu bacterial survival studies determine longevity: in watercourses, offshore of beaches, in sediments, and in milkhouse washwater tiles.
- 2) Biotracer studies determine the speed and nature of travel for bacteria introduced into a watercourse.
- 3) A liquid manure spreading study examines bacterial movement through the soil column and exiting field tile drains.
- 4) A target sub-basin study evaluates the effectiveness of a watershed with comprehensive remedial measures.

Numerous demonstration farms have been established with the cooperation of local farmers to display innovative management practices. Research continues on their effectiveness at improving water quality.

Comments and/or questions on this report are welcome. Please send written comments to:

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CLEAN UP RURAL BEACHES

CURB PLAN - PEPPERLAW BROOK DRAINAGE BASIN

1989

Prepared by: The Lake Simcoe Region Conservation Authority.

For: The Ministry Of The Environment.

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CURB PLAN - PEFFERLAW BROOK

Lake Simcoe Region Conservation Authority Rural Beaches Impact Study

SUMMARY

The CURB (Clean Up Rural Beaches) Plan report is a document outlining the remedial projects required to improve water quality in the Pefferlaw Brook drainage basin. Water pollution resulting from various agricultural related contaminants has lead to beach closures in recent years. This has resulted in the impairment of the recreational potential of beaches on Pefferlaw Brook and on Lake Simcoe within close proximity of the river outfall.

The CURB Plan is based on extensive farm practice inventories, pollution delivery capability, manure management, water quality data and beach posting frequencies. Priorities were placed on projects in the remedial plan based on pollution severity, potential pollution reductions, cost of remediation and the type of pollution input whether continuous or discontinuous. Costs were calculated using 1987 information for labour and materials.

The results of the CURB study is a prioritized list of required remedial projects and/or changes in manure handling practices which will reduce the impact of agricultural practices on water quality of local rivers impacting on target beaches. These projects have been categorized into two groups based upon their cost efficiency relative to the potential reduction in water pollution. These groups are referred to as "Priority A" and "Priority B" projects.

Priority A projects include restrictive livestock access to surface waters and controlling the discharge of milkhous wash water. Within the Pefferlaw Brook drainage basin there are 36 potential Priority A projects which can be implemented at a total cost of \$26,424 (in 1987 dollars).

The Priority B projects will focus on manure storage and feedlots as well as improving manure spreading technique. There are 64 farm operations included in this category with project costs totalling \$613,422 (in 1987 dollars).

If all remedial projects were completed in the Pefferlaw Brook, the result would achieve an 86% reduction of the pollution presently released by the identified farms. Combining the Priority A and Priority B groups, a total of 100 projects would be undertaken as part of the CURB Plan. The sum total of all these projects is \$639,846 (as of 1987).

CURB PLAN - PEPPERLAW BROOK

Lake Simcoe Region Conservation Authority Rural Beaches Impact Study

FORWARD

The CURB (Clean Up Rural Beaches) Plan report is a document outlining the remedial projects required to improve water quality in the Pepperlaw Brook drainage basin. Water pollution resulting from various agricultural related contaminants has lead to beach closures in recent years. This has resulted in the impairment of the recreational potential of inland beaches of Pepperlaw Brook and those on Lake Simcoe within close proximity of the river outfall.

The CURB Plan is based on extensive farm practice inventories, pollution delivery capability, individual manure management practices, water quality data and beach posting frequencies. Remedial projects are suggested for each farm contributing to bacterial pollution to the Pepperlaw Brook. Priorities are placed on projects in the remedial plan based on pollution severity, potential pollution reductions, cost of remediation and the type of pollution input whether continuous or discontinuous. Costs are calculated using 1989 information for labour and materials.

DISCLAIMER

The material presented in this report, both quantitative and qualitative, does not necessarily constitute policy or approved management priorities of the Lake Simcoe Region Conservation Authority. Interpretation and evaluation of the data and findings should not be based solely on this specific report. Instead they should be analyzed in light of other reports produced within the comprehensive framework of the Rural Beaches Impact Study.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the members of the Rural Beaches Technical Committee for their time and effort throughout the Beaches study.

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CURB - CLEAN UP RURAL BEACHES PEPPERLAW BROOK WATERSHED REPORT

1.0 LAKE SIMCOE RURAL BEACHES IMPACT STUDY

1.1 Introduction

The Lake Simcoe Rural Beaches Impact Study (LSRBIS) began on March 1, 1986 as part of the Ontario Ministry of the Environment's (MOE) Provincial Rural Beaches Management Strategy. The study was initiated in response to wide-spread beach postings occurring throughout the Lake Simcoe watershed thought to be resulting from agricultural land-use activities.

The study was designed to: identify major agricultural sources of fecal bacterial inputs to surface waters; determine the relative individual source pollution contributions, and; recommend cost effective remedial measures to reduce bacterial inputs to surface waters and thereby reduce or eliminate further beach postings.

Studies to date, have been limited to two sub-basins of the Lake Simcoe watershed, namely the Pepperlaw Brook and Beaverton River. The Pepperlaw Brook sub-basin was selected prior to the study as a pilot watershed due to it's high density of livestock farm operations and frequency of beach postings. Investigations of bacterial sources in the Beaverton River sub-basins were initiated during the summer of 1987 alongside continuing monitoring efforts in the Pepperlaw Brook sub-basin.

This report examines the manure management practices in the Pepperlaw Brook watershed and summarizes investigations into fecal pollution sources undertaken over the past three years of the study. It outlines the results and the methods used in the determination of:

- the identification of livestock operations potentially polluting surface waters
- the relative contribution of individual sources determined to be providing fecal pollution inputs to surface waters.
- remedial measures designed to reduce bacterial pollution from agriculture, the costs associated with them, and their proposed reduction of the bacterial pollution.
- the prioritization of remedial measures considered for implementation based on their cost effectiveness.
- the ranking of beach areas within the Pepperlaw Brook to prioritize remediation.

The report also provides a framework for the implementation of remedial measures designed to achieve the study objectives. This framework includes an inventory of suggested remedial measures and their costs for each beach in the study area.

1.2 Methodology

In order to eliminate beach postings, individual source inputs must be reduced so that the fecal coliform geometric mean concentration, measured at a beach, is consistently below the MOE recreational water quality guideline. To this end, the study methodology listed below is presently being employed in the Pepperlaw Brook and Beaverton River watersheds.

Step 1

The first step is to determine the relative individual contributions from fecal pollution sources in relation to beach postings. This requires that; a.) individual sources of fecal inputs be identified, b.) their relative pollution inputs to surface waters be quantified, c.) the changes in pollution severity due to instream processes, be assessed.

Step 2

Having obtained the above information, an estimate of the total pollution severity score can be determined by summing all of the scores from individual pollution sources. Further calculations to determine the effectiveness of different remedial strategies can be conducted by comparing total potential reductions with existing farm scores. Total reductions of seventy five percent in the pollution severity score should ensure significant reductions in beach postings.

Step 3

Step 3 involves the formulation of remedial measures and control options designed to achieve a reduction in the total pollution score significant enough to eliminate or reduce beach postings. For each pollution source identified an assessment of possible remedial measures, their cost, and estimated effectiveness must be examined. Benefit-cost analysis will be used in determining the prioritization of remedial measures. Only those measures which are cost effective will be considered for implementation.

Step 4

The final step is the production of a Remedial Action Plan that includes a framework for implementation. The plan will be designed to achieve the overall objective of the Rural Beaches Program, that being, the elimination of beach postings from fecal pollution. A total cost for the remedial actions necessary to reduce the bacteria concentration below the Provincial Water Quality Objective (PWQO) for each beach will be produced.

1.3 Agricultural Sources of Aquatic Pollution

With the advent of modern technology, the agricultural industry has undergone dramatic changes. Continuing economic pressure to produce more for less has forced farmers to adopt new farming methods and practices. Farm operations have become larger and more

specialized in order to intensify production. Unfortunately, increased production has resulted in the concentrations of animal waste byproducts, in the form of manure or milkhouse wastes, thereby increasing the potential for environmental problems.

Manure and milkhouse wash water contain significant amounts of bacteria and nutrients that can cause serious surface water quality degradation. Agricultural inputs of bacteria and nutrients can enter streams directly or with contaminated runoff. Farm practices which contribute to fecal pollution include; livestock pasturing especially when there is access to a watercourse, tile drains contaminated by milkhouse wash water, and runoff from improper manure storage, feedlots, pastures, and manure spread fields.

Livestock access is certainly one of the most significant sources of fecal bacteria and nutrient contamination of surface waters. Until recently, livestock access was considered the most convenient method of watering livestock and a time honoured tradition amongst most farmers. Unfortunately, when livestock have direct access to surface waters so do their waste byproducts, which when deposited, cause bacterial and nutrient contamination along with increasing the potential for herd health problems for livestock watering at the site or downstream.

Another major source of bacterial contamination is milkhouse wash water. According to recent studies (UTRCA, 1988) a large number of dairy operations surveyed had direct discharge from milkhouse to an open watercourse. Wash water from the milkhouse contains high levels of phosphorus, organic matter, and chlorine. Once the chlorine concentrations dissipate, the available nutrients and milk solids provide an ideal breeding ground for bacteria. Improper handling of milkhouse wash water resulting in the contamination of subsurface tile drains can be a serious and continuous source of bacterial and nutrient pollution.

Although not a continuous source, runoff from feedlots, inadequate manure storage, and manure spread fields, can deliver large quantities of bacteria and nutrients to receiving waters. This type of pollution requires the generation of surface runoff before contaminants can be transported to a watercourse. As a result the pollution from these practices is generally of a lower magnitude (even though animal waste accumulation is much greater, much less makes it to the watercourse). Factors influencing the significance of the pollution contribution from these farm practices are; the manure accumulation, the distance to a watercourse, the slope, the area contributing runoff, the existing soil cover, and the intensity and magnitude of the runoff event.

2.0 DESCRIPTION OF THE STUDY AREA

2.1 Location

The Lake Simcoe drainage basin is located in Southern Ontario approximately 50 km north of Toronto and has a total land and water surface area of 3,562 square kilometres (LSEMS, 1985). Lake Simcoe is southern Ontario's largest body of water, excluding the Great Lakes, and represents one of the most valuable natural features within Ontario. It is a multi-functional natural resource providing recreational and commercial opportunities, water supply, and effluent dispersion for sewage treatment plants.

The drainage basin is comprised of eight distinct sub-basins containing 35 tributary rivers, with five major tributaries draining 60% of the watershed (Figure 2.0). The eight sub-basins are the Holland, Maskinonge, Black, Beaverton and Talbot Rivers, the Pefferlaw Brook and the Northeast and Northwest drainage areas.

The Pefferlaw Brook sub-basin was selected as a pilot watershed because of its relative high density of livestock operations and the frequency of beach postings. Located in the south west corner of the Lake Simcoe watershed (Figure 2.1) the brook and its tributaries drain an area of approximately 420 square kilometres or 15% of the total land in the Lake Simcoe watershed.

2.2 Soils and Physiography

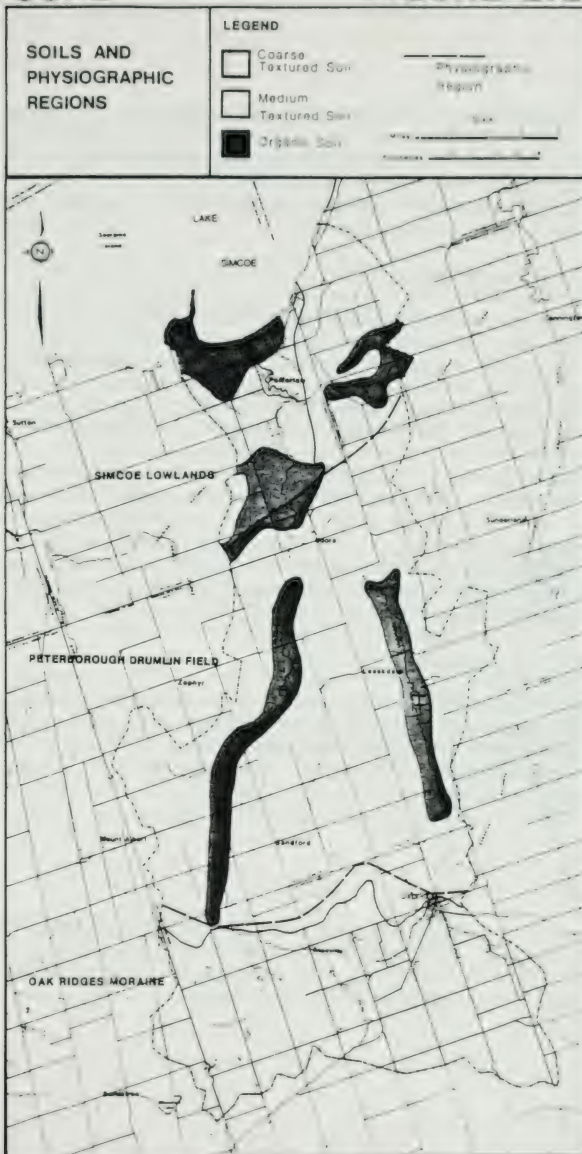
The Pefferlaw Brook sub-basin contains three major physiographic units which can all be attributed to glacial action in the Wisconsin Ice Age. Physiographic unit boundaries correspond closely to areas of differing soil textural class found within the sub-basin (Figure 2.2).

The most southern portion of the sub-basin is located in the Oak Ridges Moraine. The moraine accounts for approximately 25% of the total drainage area. Soils are coarse textured sandy loams with good drainage. The Peterborough Drumlin Field is dominated by medium textured soils with organic soil deposits along the main branch of the Pefferlaw Brook and Uxbridge Brook tributary. The drumlin field lies between the Oak Ridges Moraine and the Simcoe Lowlands and comprises roughly 60% of the drainage area.

The Simcoe Lowlands contains nearly equal proportions of all three of the previously mentioned soil textural classes. This area is located between the Peterborough Drumlin Field and Lake Simcoe. The lowland's area comprises the remaining 15% of the Pefferlaw Brook drainage basin.







2.3 Drainage

The Pefferlaw Brook has an average annual discharge of approximately 3 cubic metres per second. The headwaters of the brook originate in the Oak Ridges Moraine. The brook also drains parts of the Peterborough Drumlin Field and, near the mouth, the Simcoe Lowlands. The brook has two branches, the main branch, referred to as the Pefferlaw Brook, drains the west side of the watershed and the largest of its tributaries, the Uxbridge Brook, drains the south east side.

2.3.1 Pefferlaw Brook

The total length of the Pefferlaw Brook from headwaters to mouth is approximately 40 km. The headwaters are at an elevation of 320 metres above mean sea level (a.m.s.l.) dropping to roughly 219 metres a.m.s.l. The brook flows into Lake Simcoe between Sunnybrook Beach and Riverview Beach. Before reaching the lake the brook flows 10 km through the Pefferlaw urban area. Near the midpoint of this reach a tributary enters from the east. This tributary flows through the village of Wilfrid.

The confluence of the Uxbridge and Pefferlaw Brooks is located five kilometres south of the Pefferlaw urban area. The Pefferlaw Brook upstream of the confluence drains an area of approximately 160 square kilometres. Immediately above the confluence the brook flows through a cottage/residential area known locally as the Estonian Camp. Mud Lake, located on-stream 7 km upstream of the confluence, has a surface area of 0.25 square kilometres. The hamlets of Sandford, Roseville, Siloam, and Coppin's Corners are also within this sub-basin.

2.3.2 Uxbridge Brook

The Uxbridge Brook drains an area of approximately 175 square kilometres. It flows approximately 30 km dropping from the headwaters 328 metres a.m.s.l. to 232 metres a.m.s.l. at the confluence of the Pefferlaw Brook. Wagner Lake is located on-stream 10 kilometres above the confluence. The lake has a surface area of 0.40 square kilometres. The smaller, on-stream Elgin Pond is located in the Town of Uxbridge. The hamlets of Udora, Vallentyne, Leaskdale, and Victoria Corners are also within the sub-basin.

2.4 Land Use

Land use within the 420 square kilometre Pefferlaw Brook drainage basin is predominantly agricultural. Approximately 58% of the watershed's total land area is farmland. Only 4% of the area is urbanized. The remaining 38% is in its natural state, idle, used for transportation corridors or aggregate extraction.

2.4.1 Agriculture

The Pefferlaw Brook drainage basin supports approximately 550 farms the majority of which are livestock operations. Statistics Canada census data on numbers of livestock in 1981 were mapped during the Lake Simcoe Environmental Management Strategy (LSEMS) study (LSEMS Technical Report, A.6, 1985). These maps indicate higher than average livestock and poultry densities in the Pefferlaw Brook drainage basin compared to the remaining Lake Simcoe sub-basins.

Cropping activities in the Pefferlaw Brook basin are dominated by the cultivation of row crops, small grains, and hay. There are a number of orchards and a small cultivated marsh area adjacent to Mud Lake which produces a variety of vegetables.

2.4.2 Built-Up and Industrial Areas

The major urban centre in the Pefferlaw Brook watershed is the Town of Uxbridge which has an estimated population of 4,500. The town supports two major industries which produce chrome auto parts and propane tanks. The storm and sanitary sewer networks of Uxbridge are completely separate. Stormwater is discharged directly to the Uxbridge Brook. Sanitary and industrial wastewater is treated at a local sewage treatment plant with effluent from the plant discharged to the Uxbridge Brook.

The next largest centre is the hamlet of Pefferlaw which has an estimated population of 3,000. The town supports tertiary industry providing services for the surrounding rural community. Residential areas depend on septic systems for wastewater treatment. Pefferlaw has a storm sewer network which discharges into the Pefferlaw Brook.

Other smaller communities exist in the watershed including the hamlets of Udora, Leaskdale, Sandford, Vallentyne, Roseville, Wilfrid, Coppin Corners, Victoria Corners, and Siloam. These remaining hamlets consist of small groups of homes and services such as schools, churches, and retail operations. Houses in these areas use private septic systems for sanitary waste disposal. The numbers of storm sewers servicing these areas are very limited.

3.0 BEACH AREAS IN THE PEPPERLAW BROOK

3.1 Introduction

Lake Simcoe offers a number of recreational opportunities throughout the summer. Swimming has been identified as the most popular activity of tourists visiting the Lake Simcoe area (LSEMS, 1985). There are approximately 150 beaches in the Lake Simcoe watershed of which roughly half or 72 are within the Conservation Authority's area of jurisdiction. A total of 15 are found within the Pepperlaw Brook sub-basin, 11 of these 15 beaches are located on the shores of Lake Simcoe and 4 inland on the Pepperlaw Brook. For the purposes of this study only the Pepperlaw Brook beaches are of concern, whereas later projects will discuss the remaining beaches in and around the Lake Simcoe area.

Information was collected on each beach of the Pepperlaw Brook sub-basin regarding the history of beach postings and data on aquatic, physiographic and socio-economic conditions. The data was used to identify beach sites requiring attention and to estimate the individual beach's recreational value in order to prioritize remedial measures.

3.2 Beach Postings

Beaches in the Pepperlaw Brook sub-basin are posted by the York County and Durham Region Municipal Health Units when fecal coliform concentrations exceed the Ministry of the Environment and the Ministry of Health's recreation Provincial Water Quality Guidelines of Ontario of 100 organisms/100 ml. The health risks to bathers are associated with pathogens which include bacteria, protozoa, fungi and viruses in the water. Exposure can result in ear, eye and throat infections along with intestinal diseases.

Information regarding beach postings in the Pepperlaw Brook watershed was compiled from the local health unit records (Appendix A: Criteria For Beach Closure). Between 1986 and 1988, all five of the beaches in the Pepperlaw Brook drainage basin were posted due to high fecal coliform counts (D. Payne, pers. comm., 1988; B. Stroughan, pers. comm., 1988). The placarded beaches include Estonia Camp, Pepperlaw Dam, Elgin Pond, Wagner Lake and Port Bolster (Figure 3.0). The number of beach postings and their duration are illustrated in Table 3.0. All of the five beach areas are located inland on the Pepperlaw Brook with the exception of Port Bolster which is located near the river mouth into Lake Simcoe. For the purpose of the CURB plan only the beaches with a history of beach posting due to bacterial pollution will be discussed in detail.

CURB

FIGURE 3.0

POSTED BEACHES IN PEPPERLAW BROOK DRAINAGE BASIN

LEGEND

- | | |
|----------------|--------------------------------|
| 1 ELGIN POND | 4 PEPPERLAW DAM |
| 2 WAGNER LAKE | 5 PORT BOLSTER |
| 3 ESTONIA CAMP | --- DRAINAGE BASIN
BOUNDARY |



Table 3.0

Beach Posting in the Pefferlaw Brook Sub-basins
During The Period June 1 to September 1 (1986 - 1988)

Beach	Duration of Beach Postings (Days)			Total
	1986	1987	1988	
Elgin Pond	48	7	0	55
Estonia Camp	7	7	28	42
Port Bolster	0	0	14	14
Wagner Lake*	7	-	-	7
Pefferlaw Dam	7	7	42	56

*Wagner Lake was not sampled after 1986.

3.3 Cost Of Lost Recreational Opportunities

During the period 1986 to 1988, the Pefferlaw brook drainage basin suffered a loss of recreational dollars as a result of beach closure. These beaches, the number of posted days and their associated total lost recreational dollars are displayed in Table 3.1. The cost of lost recreational opportunity was calculated by first determining the number of people per front metre of beach and then converting this to the beach carrying capacity (Appendix B: M.O.E. Methodology of Calculating Beach Carrying Capacity). This figure was adjusted to the number of days of beach closure and then multiplied against an expenditure factor representing the average money spent by a beach user. In 1988 dollars this amount was equal to an average \$20 per person per beach use occasion in Southern Ontario (M.O.E., 1987). This cost is the collective economic loss to all participants in the local recreational industry. Although the Ministry of the Environment has determined that \$20 is representative of the amount spent by individual beach users, it is used in this report for comparative purposes only. A more accurate cost of lost recreational dollars for the beaches in the Lake Simcoe area would require further research beyond the scope of this study.

The total lost recreational dollars in the Pefferlaw Brook drainage basin between 1986 and 1988 was \$347,340. Elgin Pond beach had the highest total lost cost of \$137,800, followed by Pefferlaw Dam with a total of \$104,160. These high dollar figures are indicative of the frequency of beach closures and the resulting loss of beach use.

The estimated cost of lost recreational opportunity can be combined with beach rank to aid in the selection of priority beach sites for remedial funding.

Table 3.1

Lost Recreation Dollars In The
Pefferlaw Brook Drainage Basin

Beach Area	Total Days of Beach Closure	Cost Of Lost Recreation Dollars
Elgin Pond	55	137,800
Pefferlaw Dam	56	104,160
Estonia Camp	42	57,960
Port Bolster	14	34,160
Wagner Lake	7	13,260

3.4 Beach Ranking

During the summer of 1988 a detailed inventory of beach sites was conducted to evaluate site characteristics (see Appendix C: Methodology of Beach Ranking). The findings of this study were used to create a ranking of all the beaches in the south Lake Simcoe area, together with their potential level of use. From the results a prioritized list of beach locations in the Pefferlaw Brook was established. The five beaches, in rank order, are Elgin Pond, Estonia Camp, Port bolster, Wagner Lake and Pefferlaw Dam.

The beach ranking results were based upon measured determinants evaluating aquatic conditions, physiographic factors and developed amenities. Together, these characteristics were used to calculate a beach score as an assessment of the beach value (Table 3.2). The aquatic features alone are not always the best characteristics to judge the overall desirability of a beach. In Pefferlaw Brook, it is apparent that the preferred beaches, as indicated by score, are influenced by developmental factors instead of just physical characteristics of the site. Development scores are highest for the best ranked beaches which shows the importance of such features as stores and playgrounds. Three of the beaches, Elgin, Estonia and Wagner had similar physiographic scores. The other two beaches, Pefferlaw Dam and Port Bolster, scored poorly in this respect and also exhibited less acceptable aquatic features.

Table 3.2

Beach Determinant Scores And Rank

Beach Areas	<u>Determinants</u>			Beach Rank
	Aquatic	Physio-graphic	Development Management	
Elgin Pond	35	55	15	1
Port Bolster	72	25	25	2
Estonia Camp	42	55	30	3
Wagner Lake	24	55	15	4
Pefferlaw Dam	47	21	25	5

These scores are representative of overall beach value, which leads to the recreational demand placed upon the particular site. Judging from these beach scores, the CURB plan should address remediation which would improve water quality at beach sites in order from highest to lowest ranked beach. The results would allow the most active beaches and those perceived to be of highest value to be kept in a condition suitable for recreational use.

3.5 Beach Descriptions

3.5.1 Elgin Pond Beach

Elgin Pond beach is located in the Town of Uxbridge on the Uxbridge Brook, a tributary of the Pefferlaw Brook. Originating in the Oak Ridges Moraine, the brook flows a distance of roughly 5.5 km draining an estimated 47.5 sq/km before reaching the beach at Elgin Pond. The Elgin Pond beach was ranked 34 out of 59 beaches within the South Lake Simcoe area. This sand beach is approximately 100 metres long and includes a park and picnic area. The geographical location of the beach within the Town of Uxbridge makes it readily accessible to local residents and as a result is used extensively throughout the summer.

Aquatic Determinants

This beach site exhibits typical aquatic characteristics associated with silt and muck bottomed ponds. Water clarity is moderate, partly due to the dark sediment type and the suspended detrital material. Aquatic weeds are not considered a problem at Elgin Pond although the occasional algal bloom has occurred.

Physiographic Determinants

Elgin Pond has approximately 100 metres by 3 metres of sand beach with an accompanying 2 acres of grassed parkland. The beach is shallow with a gentle slope towards deeper water. The bottom composition is firm near shore and progressively softer in deeper water.

Development and Management Determinants

There are not many amenities close to Elgin Pond. It has no washroom facilities, parking or playground. However the beach is in close proximity to a variety of stores and restaurants as well as the homes of local residents in Uxbridge. The picnic area is equipped with a few picnic tables.

3.5.2 Wagner Lake

Wagner Lake is located on the Uxbridge Brook north of the Town of Uxbridge and southeast of the Hamlet of Leaskdale. The lake has a surface area of 3.2 sq/km and drains an area approximately 98.75 sq/km in size. The lake is surrounded by cottages and permanent residential dwellings. There is no public beach area adjacent to the lake perimeter, although local cottagers and residents extensively use the lake for recreational swimming.

Aquatic determinants

Wagner Lake is an shallow enriched lake often plagued by algal blooms and aquatic weeds. The bottom substrate is a combination of sand and silt. Water clarity is moderate and water colour was blue changing to green during periods of algae growth.

Physiographic determinants

There is no public beach on Wagner Lake. Shoreline beaches of private landowners vary in size and substrate. A wetland swampy area persists at the southern end of the lake which aids in the removal of silt.

Development and Management Determinants

Wagner Lake is isolated from any public facilities such as public washrooms or picnic areas. The most common users of the lake are local private landowners with direct access to the lake.

3.5.3 Estonia Camp Beach

The Estonia Camp Beach is located on the main branch of the Pepperlaw Brook in the Village of Udora. The Pepperlaw Brook originates within the Oak Ridges Moraine approximately 21.25 km south of Estonia Camp and drains an area roughly 136.6 sq/km in size. An artificial berm was constructed across the brook to create a pond for swimming and the sand beach. The pond has a surface area of approximately 0.6 sq/km.

Aquatic Determinants

This beach area has very poor water clarity due to the dark brown colour of the pond water. Aquatic weeds and algae are moderate, however a distinct unpleasant odour was noticeable. Duckweed is occasionally found floating in the pond and at the swimming area.

Physiographic Determinants

The Estonia Camp Beach is approximately 40 meters in length but only 1 meter in width. The beach has a very gentle slope with the substrate and beach composition dominated by organic silt and detritus. The dry beach is essentially a large level grassed area.

Development and Management Determinants

The Estonia Camp Beach area is a privately owned camp site. The beach area is isolated from any public picnic facilities or amenities, however, washroom facilities are located nearby. The campground site is located 100 - 200 meters from the beach area.

3.5.4 Pepperlaw dam

The Pepperlaw Dam is located in the north end of the Pepperlaw Brook watershed in the Town of Pepperlaw. While no sand beach exists the grassed park area provides public access to the mill pond for recreational swimming. The estimated drainage area is approximately 391 sq/km which includes all the drainage sub-basins of the beach areas upstream on the Pepperlaw Brook.

Aquatic Determinants

The Pepperlaw Dam swimming area exhibited marginal water clarity that was brown in colour. Algae and aquatic weeds were light to moderate and no odour was noticed.

Physiographic Determinants

There is no sand beach area located at the Pepperlaw Dam. Bottom substrate is composed primarily of sand and silt. The grassed dry beach area is approximately 75 meters in length with a gentle slope.

Development and Management determinants

The swimming area is located in the centre of the Town of Pefferlaw although no public washrooms or picnic facilities are available at the site. Variety stores and other amenities are nearby in the town and the majority of beach users live in Pefferlaw.

3.5.5 Port Bolster Beach

The Port Bolster beach is located on Lake Simcoe approximately 0.5 km northeast of the mouth of the Pefferlaw Brook and on the west end of the town of Port Bolster. The major source area of impact to the beach is the Pefferlaw Brook watershed. The lake current travels eastward past the river mouth on towards Port Bolster Beach.

Aquatic Determinants

The clear blue water of Lake Simcoe provides for good water clarity at this beach area with very little aquatic weed growth, odour or any other unpleasant features. Algae may persist at certain times of the year.

Physiographical Determinants

The Port Bolster Beach is approximately 150 meters in length and 3 meters across with a gentle 2% slope. The beach area and the bottom substrate are dominated by cobble sized stone intermixed with sand and gravel.

Development and Management Determinants

The Port Bolster beach area offers a picnic area with free parking of up to 25 vehicles. No public washrooms or other amenities are available. The town of Port Bolster is very small and offers little in terms of public stores or restaurants. Users of the beach area are primarily local cottagers or residents along the lake.

4.0 METHODS OF SOURCE ASSESSMENT

4.1 Introduction

Fecal pollution origins can be categorized into natural or man-made sources. In the Pepperlaw Brook sub-basin, the natural source contribution to water quality degradation is insignificant when compared to inputs from man-made sources. Urban, industrial, and in particular, agricultural activities are undoubtedly responsible for the largest percentages of the fecal pollution entering surface waters in populated areas.

The intent of the Lake Simcoe Rural Beaches Impact Program is to address surface water quality problems originating from agricultural sources of fecal contamination. Contamination of surface water by urban and industrial sources of fecal pollution are to be addressed through other MOE initiatives such as the Municipal Industrial Strategy for Abatement (MISA) program.

4.2 Bacterial Source Identification

Intensive on site investigations were required to determine whether the operational practices of livestock farms contribute to bacterial contamination of surface waters. The large number of livestock operations and size of the Pepperlaw Brook watershed render an investigation of this scale impractical. In order to limit the number of farm visits and ensure that all problem areas were identified, a methodology to target farm visits was devised.¹

Airphotograph Interpretation

The first step in the identification of problem livestock operations involved the use of airphotographs to locate all livestock and poultry operations within the Pepperlaw Brook drainage basin. Livestock and poultry operations were identified using interpretive techniques employed in earlier studies (Ryan, 1982; Balian, 1982). A total of 613 farms were identified of which 449 were believed to house livestock or poultry. Livestock operation locations were mapped on to 1:50,000 scale topographic sheets for later use.

Sediment Delivery Capability

The second step in the methodology to target farm visits utilized the development and use of sediment capability maps after the Land's Directorate (Snell, 1984). These maps were produced onto 1:50,000 mylar sheets and display a land area's tendency to generate runoff and contaminate surface waters. These maps were then overlaid onto the

¹ The methodology was based, in part, on previous work completed by Upper Thames River and the Ausable-Bayfield Conservation Authorities.

topographic sheets depicting the location of livestock farms. Farm operations which were located in high and moderate sediment delivery areas were targeted for future investigations, operations located in low sediment delivery capability areas were not to be given further consideration.

Targeting of Farm Visits

Livestock operations which received a high or moderate rank were targeted for detailed site assessment. The greatest reduction of harmful inputs are likely to be achieved at these locations. Low ranked farms are not expected to contribute to fecal contamination however, to ensure that the methodology used in targeting detailed farm visits is accurate a number of low ranked farms will be randomly visited. Overall, the total number of detailed investigations required was reduced significantly from 449 to 148.

Detailed Source Assessment

Site inspections of livestock operations previously targeted in the Pepperlaw Brook were completed in 1988 and the results entered into a database for further use. A total of 148 farm visits were made, 80 to farms which had received a high pollution potential ranking, and 68 to farms classified to have a moderate pollution potential. Of the total 148 site inspections conducted, detailed information was collected for 83 livestock operations. The remaining 61 visits revealed either cash crop operations, farms which no longer had livestock, or hobby farms with very few animals.

During site inspections the individual livestock operation's manure storage and handling practices were examined and discussed in detail, along with milkhous waste disposal and livestock watering methods. An example of a survey sheet and the type of information collected can be found in Appendix D. The information was collected to further evaluate the contribution from individual livestock and poultry farms to fecal pollution and surface water quality degradation.

4.3 Pollution Severity Scoring Methodology

The objectives of the pollution severity scoring methodology were to:

- 1) Measure the relative fecal pollution contributions originating from all aspects of a livestock farm's manure storage and management practices.
- 2) Calculate reductions in fecal contamination resulting from the initiation of remedial measures associated with changes to the existing manure storage and management practices.
- 3) Estimate the costs of suggested remedial measures and using the associated reduction in pollution score calculate a cost per unit reduction so that remedial measures may be ranked based on their cost-effectiveness.

The following is a brief description of the Pollution Severity Scoring Methodology which was developed. The scoring methodology has been programmed for use on microcomputers in basic language and can be made available upon request.

4.3.1 Calculating Pollution Severity Scores

Daily Bacteria Production Per Day

The first step in the determination of farm scores is to calculate the relative concentration of Escherichia coli (E. coli) bacteria produced per day for each individual livestock operation. Documentation concerning the concentration of E. coli in animal waste was more readily available than similar information for fecal coliforms therefore E. coli was selected for use in the calculations (Seyfried, Young and Harris, 1987). It is important to note that E. coli is a specific type of fecal coliform and responsible for approximately 90% of the fecal coliform reported in the Pepperlaw Brook water column. Relative bacteria concentrations per individual livestock species are listed below.

Relative Bacteria Concentrations Produced Per Day

Beef	1.3x10 ¹⁰ E. coli per day
Dairy	1.8x10 ¹⁰ E. coli per day
Sheep	2.9x10 ¹⁰ Fecal coliform per day
Poultry	7.6x10 ⁹ E. coli per day
Horse	1.5x10 ⁹ E. coli per day
Pig	4.4x10 ¹⁰ E. coli per day

These production figures are based on:

- Bacteria figures from Seyfreid, Harris and Young, 1986; except sheep from Geldreich, 1978.
- Manure production figures from Midwest Plan 11th edition, 1983.

The priority scoring program will allow up to 3 different types of livestock to be reported. the calculation of the number of bacteria produced can be simply stated as:

$$\text{Number of Bacteria} = \sum (\text{relative}^1 \times \text{number of animals}^1) + (\text{relative}^2 \times \text{number of animals}^2) + (\text{relative}^3 \times \text{number of animals}^3)$$

The final product is a number which represents the total manure production per day for all livestock present on the farm operation.

Assessment of Transport Factors

The evaluation of transport factors is another procedure repeated during the assessment of individual manure storage and management practices. Information regarding the percent slope angle, slope length, soil texture, and soil cover must be collected for the assessment of manure storages, pasture, feedlots, and manure spread fields. These factors, when considered together, produce a measure of runoff ability which can be used to indicate overland bacterial transport (Snell, 1985). The slope of a pasture or field is scored according to the runoff velocity generated as a function of the angular measure of the land. Higher scores represent increased runoff velocity in conjunction with greater slope angle. The volume of overland flow will increase as the fetch, or runoff length, increases. For this reason slope length scores are higher for longer fetch areas. Soil texture can affect the volume of runoff by its permeability and erodability characteristics. Therefore soil texture is scored according to its overall ability to restrict runoff generation. Low scores indicate soils of low runoff production, and high scores relate to increased runoff generation. Vegetation can arrest erosion and reduce runoff on pasture land. Soil cover scores reflect this by increasing with decrease in vegetation cover.

The equation used to calculate transport is listed below and was developed by the Land Directorate in Guelph (Snell, 1985).

$$\text{Transport} = (\text{Slope} + \text{Slope Length} + \text{Soil Texture} + \text{Soil Cover}) \\ \text{Factor}$$

Transport factors can range dramatically depending upon the site conditions, for example;

Site One has the following conditions:

- a % slope between >15 and <=30
- a slope length between >60 metres and <=75 metres
- a soil texture class described as clay loam
- a percent soil cover of <=20

$$\text{Transport Factor} = 4.2$$

Site Two has the exact same conditions with one exception:

- a % slope between >0.5 and <=2

$$\text{Transport Factor} = 1.6$$

The result of the scoring of transport factors produces an overall runoff ability ranking and is linked to all of the rating procedures except milkhouse wash water disposal.

Rating Manure Storage

This section offers a scoring system to assess farm manure storage facilities. Essentially, it differentiates storages which are liable to allow contaminated runoff or manure spills to enter surface receiving waters. A poor storage facility will receive a much higher score

than one which is built to acceptable standards. Manure storage systems receive the following rankings based on their construction, and distance to the nearest watercourse:

Solid/Liquid Storage

if storage is a bare yard then	$ms = 5$	(worst case scenario)
if storage is a cement pad	$ms = 4$	
if storage is a pit	$ms = 2$	
if storage is a tank	$ms = 1$	(best case scenario)

Runoff Collection

if storage is covered then	$ms = ms - 1$
if storage has a runoff pond	$ms = ms - 1$
if storage has a liner	$ms = ms - 1$
if storage has retaining walls	$ms = ms - 1$
if storage receives runoff from yard or roofs	$ms = ms + 1$
if animal capacity exceeds present storage	$ms = ms + 2$

Transport Factor

if storage is yard or pad and distance to the watercourse < 120 metres adjust for transport factor	$ms = ms + (\text{transport factor})$
---	---------------------------------------

The following is an example of the assessment procedure with Manure Storage One representative of a poor storage and Manure Storage Two an acceptable storage.

Example 1: Manure Storage One

Solid/Liquid Storage	
- has a bare yard	$ms = 5$
Runoff Collection	
- storage is not covered	(no adjustment)
- storage has no pond	(no adjustment)
- storage is not lined	(no adjustment)
- no retaining wall	(no adjustment)
- storage receives runoff	$ms = 5 + 1$
	$ms = 6$
- storage at capacity	(no adjustment)
Transport Factor	
- storage location (5)	$ms = 6 + 5$
	$ms = 11$

Manure Storage Factor = 11

Example 2: Manure Storage Two

Solid/Liquid Storage

- has a pad $ms = 4$

Runoff Collection

- storage is not covered (no adjustment)

- has a pond $ms = 4 - 1$

$ms = 3$

- storage is lined $ms = 3 - 1$

$ms = 2$

- has retaining walls $ms = 2 - 1$

$ms = 1$

- no runoff received (no adjustment)

- storage at capacity (no adjustment)

Transport Factor

- storage location (5) $ms = 1 + 5$

$ms = 6$

Manure Storage Factor = 6

Note that Example 2 still receives a score although not as large as Example 1. This is because the storage is still in close proximity to a watercourse and a spill would result in a significant amount of bacterial contamination and surface water degradation.

Rating Milkhouse Wash Water Waste Disposal

Milkhouse wash water waste disposal was examined since contamination of tile drains can contribute significant amounts of bacteria and phosphorus directly to ditches and streams. If disposed of properly milkhouse wash water receives a score of zero. Disposal systems which are considered acceptable include: holding tanks, septic tanks with weeping bed systems, treatment trenches and manure storage. Where milkhouse wash water is directly discharged through a tile drain, then milkhouse wash water receives an automatic score of ten.

Milkhouse Wash Water Disposal System

Acceptable Systems

- | | |
|------------------------------------|------------|
| - expanded Manure Storage Capacity | Mhouse = 0 |
| - Holding Tank | Mhouse = 0 |
| - Treatment Trench | Mhouse = 0 |
| - Septic and Weeping Bed | Mhouse = 0 |

Unacceptable Systems

- | | |
|--------------|-------------|
| - Tile Drain | Mhouse = 10 |
|--------------|-------------|

Rating Livestock Access

Pasture practices are included in the calculation of the farm score. Any access that livestock have to a watercourse pose a potential risk of bacterial contamination via direct fecal inputs from the animals themselves. Direct access earns the highest score for pasture practices at ten. When livestock do not have direct access to a watercourse, but are within 120 metres of a stream or ditch, then overland transport factors must be considered. The transport factor is calculated to adjust the pasture score according to site specific conditions. The assessment is shown below;

Livestock Access

- | | |
|---|---------------------------|
| - if livestock have access to surface waters | Past = 10 |
| - if livestock access is restricted and is located > 120 metres from surface waters | Past = 0 |
| - if livestock access is restricted but located < 120 metres from surface waters | Past = (Transport Factor) |

Rating Manure Spreading Practices

Runoff generated on manure spread fields can ultimately wash soil and manure into ditches and streams contributing to serious water quality problems. The time of year application occurs can determine the vulnerability of surrounding watercourses to contamination. The worst case scenario is manure spreading during winter months while the ground is frozen. Come spring melt much of the manure and fecal bacteria can be transported by runoff to nearby waterways. Application of manure in spring, summer or fall also pose a risk to bordering waterways if manure is not incorporated into the soil. Transport factors of the manure spread field strongly influence it's ability to generate polluted runoff. For this reason the transport factor is reflected in the manure spreading practice scoring methodology. Other improper spreading practices such as spreading to close to a watercourse or over application were not assessed at this time. Scoring criteria for manure spreading practices are as follows;

Manure Spreading Practices

- | | |
|---|-----------------------------|
| - if manure is spread in winter months | mfield = 10 |
| - if manure spread field is < 120 metres to a watercourse | mfield = (transport factor) |
| - if manure spread field is > 120 metres to a watercourse | mfield = 0 |

Calculating the Final Pollution Severity Score

The calculation of the final pollution severity score combines all of the above mentioned practices into one equation producing a total pollution severity score based on the entire farm's storage and manure management practices. The equation is as follows:

$$\text{Final Pollution Severity Score} = \frac{\text{Number of Bacteria Produced per Day} \times \sum \text{of the integers ms, past, mfield, mhouse}}{\text{Produced per Day}}$$

4.3.2 Calculating Reductions Resulting from Remediation

The calculation of reductions in pollution severity score resulting from the initiation of remedial measures is accomplished by simply repeating the scoring methodology procedure and substituting the proposed remedial measures into the data base replacing the manure management practices originally in place on the farm. This revised score can then be subtracted from the original pollution severity score to yield the overall farm reduction in fecal pollution. Proposed remedial measures included 200 day manure storage with runoff collection, milkhouse wash water treatment systems, restricting livestock access, the planting of buffer strips, above water stream crossings, and alternate watering facilities.

4.3.3 Estimating the Cost of Remedial Measures

Cost estimates were calculated for each component of a livestock operations manure storage and management practices where a reduction in the pollution severity score could be achieved. Costs for materials and labour were based on information collected from the Ministry of Agriculture and Food (Flemming, 1988) and local fencing contractors.

Total costs for manure storage varied for each operation as did costs estimates for restricting livestock access based on the individual operations requirements. Accurate cost estimates for milkhouse wash water treatment systems were not available therefore it was suggested that an estimated cost of \$3,000.00 be used. Cost estimates for manure spreading were not determined due to inadequacies in the survey data collected.

4.3.4 Calculating the Delta/Cost Ratio

The delta/cost ratio is defined as the product of a simple calculation where the estimated cost of a remedial measure is divided by the proposed reduction in pollution severity score. The result represents the cost per unit reduction in pollution severity score which could

be achieved through implementation of the specific remedial measure. The ratio was used to prioritize remedial measures for implementation and is essential in the formulation of the CURB Remedial Plans.

4.4 Bacterial Source Significance

Bacterial contamination of surface water associated with agriculture land use is specific to livestock farming and occurs through the mismanagement of livestock wastes and milkhous wash water. Bacteria can enter surface waters directly through the discharge of urine, feces, and wash water, and indirectly, as contaminated runoff. It is important to distinguish between the two when assessing the relative impact of their contributions to surface water quality degradation.

Direct source inputs are considered the most significant agricultural sources of bacterial contamination, with inputs occurring continuously and discharged directly to surface waters. Subsequently, farm practices providing direct inputs have been given the highest priority within the CURB ranking for remediation. Farm practices providing direct inputs include livestock access, and faulty milkhous waste water disposal systems and have been classified as **Priority A Projects** requiring immediate attention.

Indirect source inputs are generally a less significant contributor to surface water quality degradation than direct source inputs, as they require rainfall or snowmelt events to generate surface runoff necessary to transport the bacteria. As a result, these sources while still significant contributors to bacterial contamination, have been classified as **Priority B Projects** requiring immediate attention after Priority A Projects have been addressed. Farm practices which provide indirect source inputs include runoff from manure storage, feedlots, manure storage and pastures.

5.0 SUMMARY OF SOURCE ASSESSMENT

5.1 Introduction

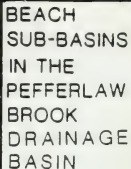
Individual farm source assessment provides information on fecal pollution severity scores and the intensity of a source input. The degree of pollution indicated by the score of an impacting farm will be in proportion to the amount and type of manure management practice of the operation involved. These scores are adjusted by the implementation of available remedial measures used to correct the pollution hazard. The result is a figure representing the potential reduction in the pollution severity score. From the suggested remedial measures, a total cost of farm rehabilitation is calculated and presented for each sub-basin.

The source assessment recognizes that inputs from upstream farm locations can, and will, influence downstream beach sites (Walters, *et al.*, unpublished). Therefore, the additional source region must be added to the downstream sub-basin totals to accurately reflect the cumulative nature of aquatic fecal pollution. This same argument is used with potential reduction and cost figures. In the Pepperlaw Brook the four sub-basins are arranged such that Wagner Lake sub-basin is a summation of both Wagner Lake and Elgin Pond sub-basins. The Pepperlaw Dam/Port Bolster sub-basin is the summation of Elgin Pond, Wagner Lake, Estonia Camp and Pepperlaw Dam sub-basins (note: the area downstream of Pepperlaw Dam to Port Bolster recorded no additional agricultural pollution sources). Figure 5.0 displays the Pepperlaw Brook sub-basins.

5.2 Elgin Pond Beach

A number of farm operations were identified within the sub-basin but only 3 were found to provide fecal pollution inputs to Elgin Pond Beach (Figure 5.1). Farms within the Elgin Pond sub-basin accumulated a total pollution severity score of 10,485, with one farm operation accounting for 81% of the sub-basin score. Pasture runoff and livestock access contributed 58% to the pollution severity score. Manure storage accounted for 31% of the pollution score and improper manure spreading practices contributed the remaining 11%.

The highest portion of fecal contamination in this sub-basin originates from poor pasturing and livestock watering practices (Figure 5.2). Unrestricted animal access to waterways allows direct input of manure (58%) into the brook draining towards beach areas. Three farms in this catchment area require remedial work to eliminate this type of pollution source. A solution to this management practice would see the fencing of the onstream watering sites and to establishment alternate watering stations. This technique could potentially eliminate all fecal pollution from livestock pasturing as well as providing many additional benefits associated with better farm management. The second highest source of pollution originates from inadequate manure storage (31%). Two farms require upgrading of their storage facilities. Only one farm contributes fecal input as a result of



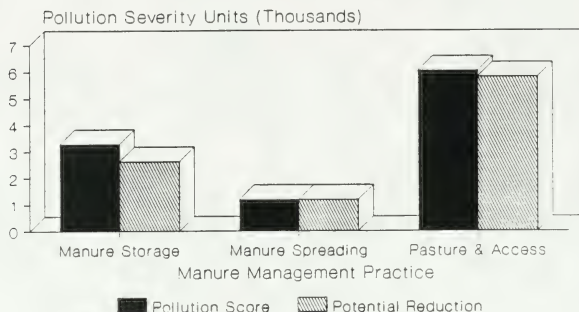
A	PEFFERLAW DAM
B	ESTONIA CAMP
C	WAGNER LAKE
D	ELGIN POND

DRAINAGE
BASIN
BOUNDARY



Figure 5.2

Elgin Pond Sub-Basin Pollution Severity Score And Potential Reductions



poor manure spreading practices (11%). In this case a no cost solution of proper spreading technique and the cessation of spreading in winter would reduce bacterial input.

It has been estimated that a total reduction of 9,541 (91%) in the pollution severity score can be achieved in the Elgin Pond sub-basin (Figure 5.1). This could be accomplished by constructing proper manure storage structures, eliminating livestock access, and educating the farm community to better manure management. Pasture runoff and livestock access can reduce approximately 55% of the pollution severity score, and the construction of proper manure storage could reduce the score an additional 25%. An estimated 11.3% reduction could be achieved by educating farmers in the proper application of manure. This would include the calculation of proper application rates using soil and manure test results along with individual crop requirements.

The costs associated with the remedial measures proposed total approximately \$7,558. Of this, manure storage accounts for approximately 83% or \$6,273 and pasture and access roughly 17% or \$1,285. Comparing the cost per unit reduction it is obvious that pasture and access appears to be most cost effective while manure storage is the least cost effective in reducing the pollution severity score of livestock operations. Remedial measures to reduce bacterial pollution impacting on the surface water quality of Elgin Pond beach should concentrate on continuous inputs before addressing event-dependant sources.

5.3 Wagner Lake

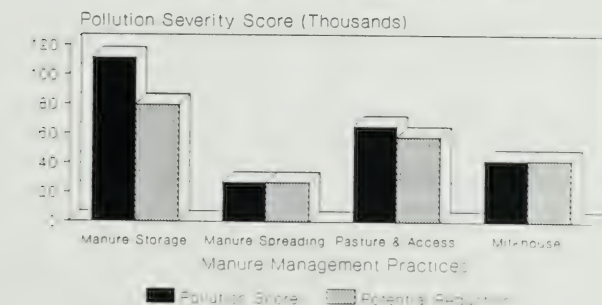
Wagner Lake is surrounded by cottages and year round residential dwellings. Livestock operations around the lake contribute bacteria pollution in addition to those already identified in the Elgin Pond reach. Bacteria contributing farms above Elgin Pond will also affect Wagner Lake's water quality. Downstream migration of fecal pollution from Elgin Pond will count as a significant source of enteric bacteria at Wagner Lake. For this reason the pollution severity units, pollution reductions, and costs reflect the cumulative value of both the Wagner Lake and Elgin Pond sub-basins.

Twenty-two additional livestock operations (Figure 5.3; see next page) impact upon the water quality of Wagner Lake, which when added to those in the Elgin Pond sub-basin, brings the total to 25 farms. The total pollution severity score impacting on Wagner Lake is approximately 245,614 units. The highest pollution severity score for a single livestock operation was 36,380, contrasting the lowest which was only 788. The average pollution score was calculated to be roughly 8,032 pollution severity units of the farms in the Wagner Lake sub-basin.

Figure 5.4 shows the total pollution severity scores for manure storage and management practices for the area above Wagner Lake. Manure storage scored the highest accounting for 45.3% of the pollution severity score. It was followed by pasture and access problems at 26.5%, improper milkhouse waste disposal 17.3%, and improper manure application at 10.9%.

Figure 5.4

Wagner Lake Sub-Basin Pollution Severity Score And Potential Reductions *



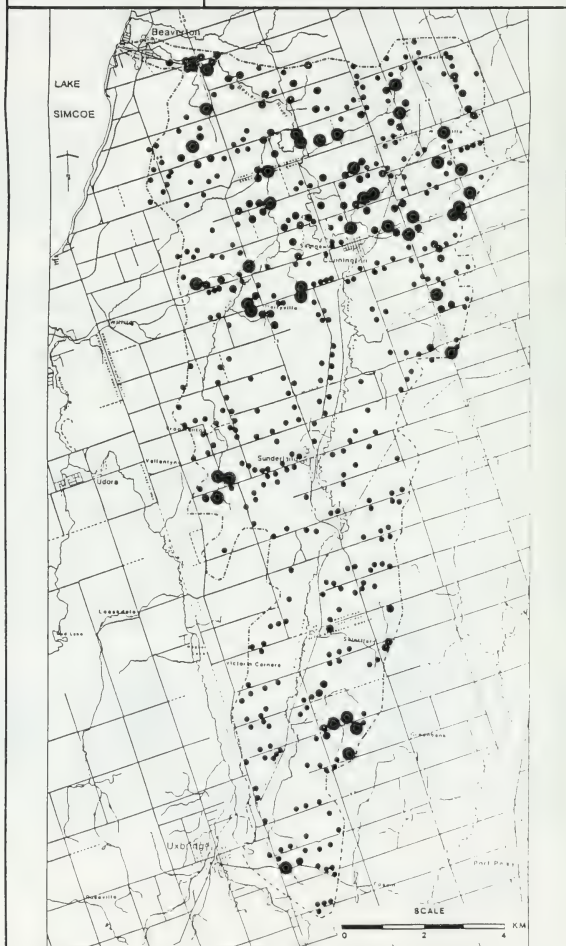
* Cumulative Of All Upstream Inputs

FARM POLLUTION
POTENTIAL
BEAVERTON RIVER

LEGEND

FARM RANKING

- HIGH
- MODERATE
- LOW



It has been estimated that a total reduction of 206,455 pollution severity units or 84.1% of the inputs upstream of Wagner Lake. This could be accomplished by constructing proper manure storage, eliminating livestock access, and educating the farm community to better manage manure. By controlling pasture runoff and livestock access an estimated 23.6% of the upstream pollution severity score can be reduced. Construction of proper manure storage and milkhouse waste disposal systems could reduce approximately 32.3% and 17.3% respectively. An additional 10.9% reduction could be achieved by educating farmers in the proper application of manure.

The total cost of remedial measures in the Wagner Lake basin are approximately \$223,595. Of this, manure storage accounts for approximately 95.5% or \$213,438, milkhouse waste disposal systems account for 1.4% or \$3,300 and pasture and access roughly 3.1% or \$6,857. Again, the no cost solution of proper manure spreading would be highly effective.

Comparing the cost of remedial measures versus the estimated reduction in pollution severity score pasture and access appears to be most cost effective. Milkhouse waste disposal systems are the next which leaves manure storage as the least cost effective in reducing the pollution severity score of livestock operations.

5.4 Estonia Camp Beach

A total of 28 livestock operations have been found to provide fecal pollution inputs which impact on surface water quality at the Estonia Camp beach (Figure 5.5). A total of 237,287 pollution severity units were recorded from the 28 farms. The maximum score reported from a single operation was 70,200 severity units, the minimum score reported was 60 severity units with the average estimated to be 8,465 units.

Figure 5.6 depicts the distribution of the pollution severity score for manure storage and handling practices in the Estonia Camp Beach basin. Manure storage accounts for the largest portion of the total pollution severity score at approximately 49% or 116,608 units. Improper manure spreading is next highest at 18% or 43,130 units followed by pasture and livestock access contributing the remaining 33% or 77,549 units.

It is estimated that a 84.4% reduction (200,243 units) in the pollution severity score can be achieved if suggested remedial measures and control options are initiated. The largest reduction attainable is through the construction of proper manure storage which could reduce 35.7% of the total score. The adoption of proper manure application practices could reduce an additional 18% and pasture and access could reduce 30.3%.

The cost of initiating the remedial measures required to achieve the above reduction has been estimated to be approximately \$233,516. Constructing proper manure storage systems for problem farms in this drainage basin has been estimated at approximately \$229,515 or 98.3% of the total cost of remedial measures. Proper pasturing and livestock access accounts for only \$4,001.00 or the remaining 1.7% of the total cost.

FARM LOCATIONS-
ESTONIA CAMP

LEGEND

----- WATERSHED BOUNDARY

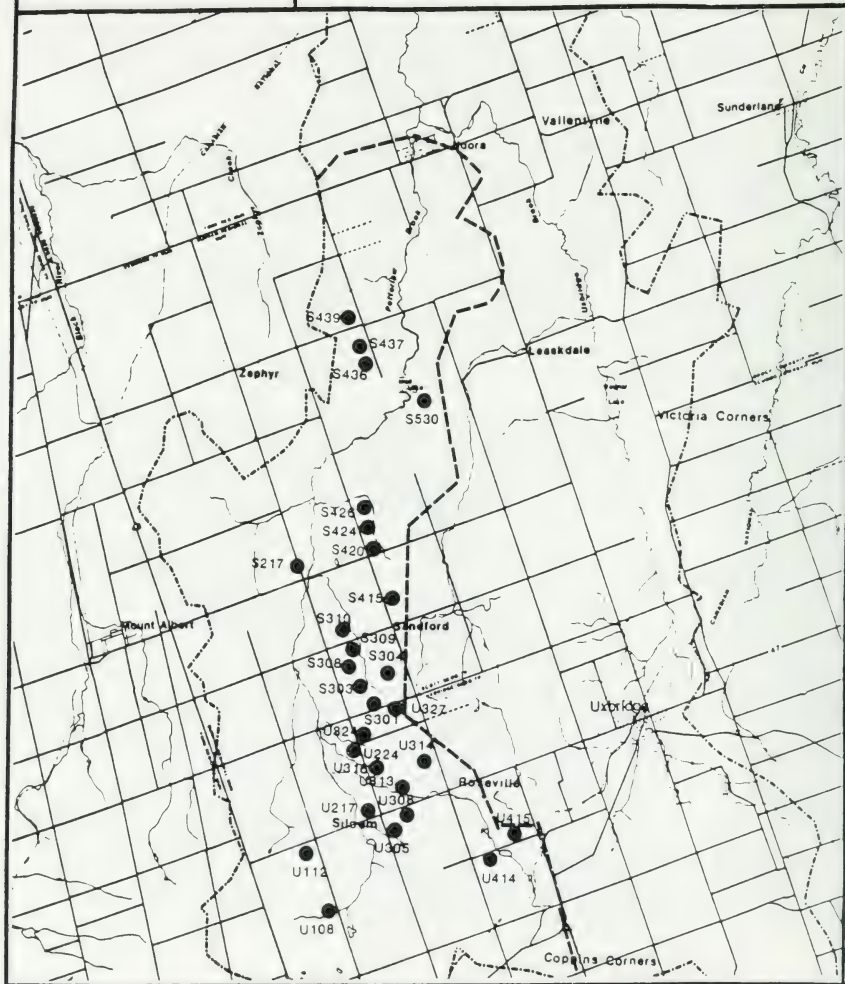
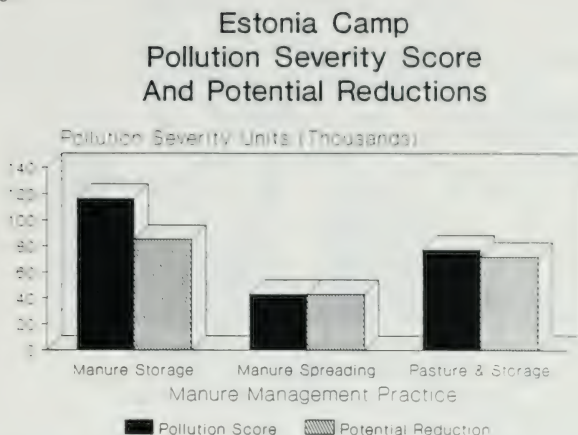


Figure 5.6



5.5 Pefferlaw Dam and Port Bolster

The Pefferlaw Dam is located in the north end of the Pefferlaw Brook watershed in the Town of Pefferlaw. While no sand beach exists the grassed park area does provide access for recreational bathing purposes. The estimated drainage area is approximately 391 sq.km and includes all the area draining to the other beaches. Therefore, farms described in the three previous sub-basins ultimately impact on this beach area. Because the impact reach for both Pefferlaw Dam and Port Bolster encompasses the entire drainage basin, the pollution score potential, reduction and cost represent the sum of all the sub-basins.

A total of 32 farm operations were visited in the Pefferlaw sub-basin, of which 16 were found to be significant contributors of fecal pollution (Figure 5.7). This brings the total farms in the drainage basin to 69. The highest individual farm pollution severity score recorded for this sub-basin is 51,840 units, the lowest score recorded is 1,950 units and the average score per operation is 16,717 units.

The total farm pollution severity score from the additional operations increases the drainage basin total to 750,374 units. Runoff from manure storage contributed the most towards the total pollution severity score at 44.2% (Figure 5.8). Pasture and livestock access to a watercourse followed with 30.9%, then improper application of manure at 17.2%. Inadequate milkhous waste systems scored the lowest of all the pollution sources contributing only 7.6%.

FARM LOCATIONS -
PEPPERLAW DAM

----- LEGEND
WATERSHED BOUNDARY
● FARM

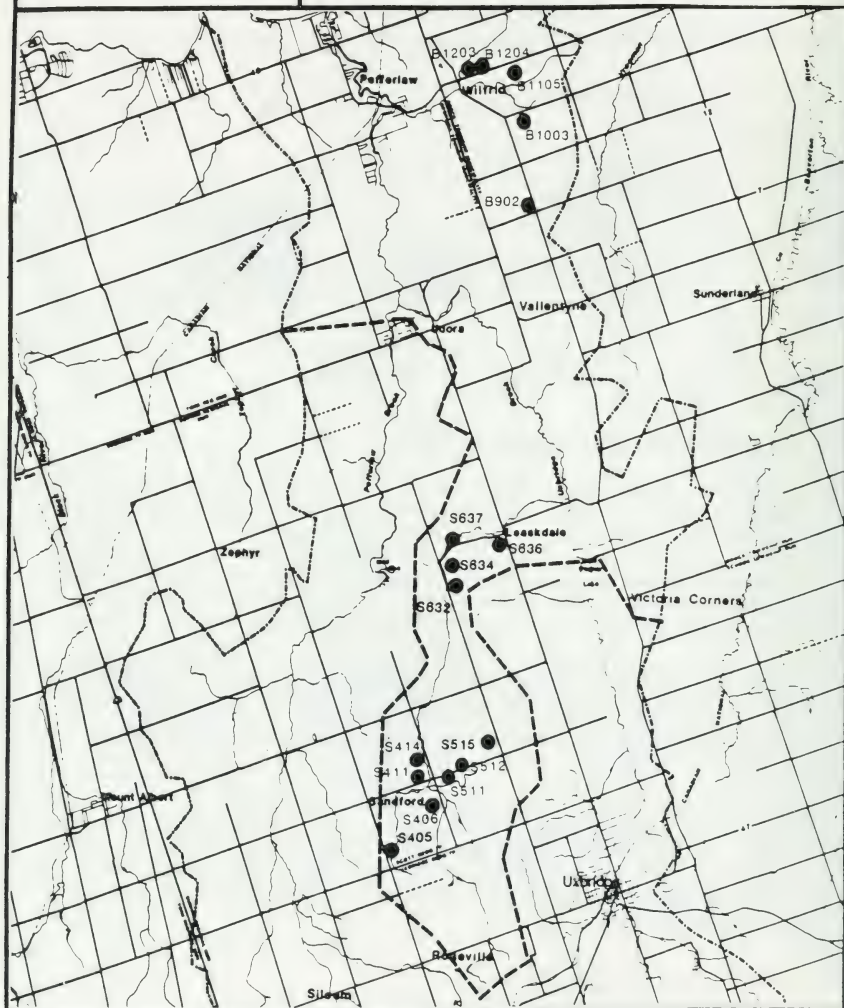
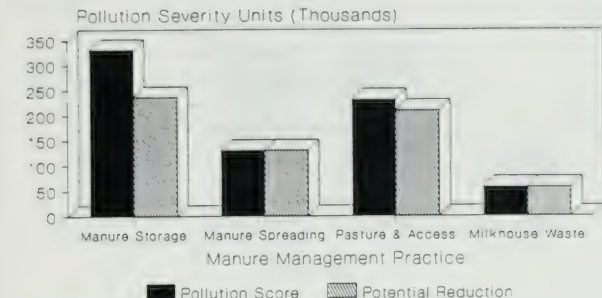


Figure 5.8

Pefferlaw and Port Bolster Pollution Severity Score And Potential Reductions *



* Cumulative Of All
Upstream Inputs

Remedial action to reduce agricultural fecal pollution in the river reach above Pefferlaw Dam will decrease the pollution score by 84.4%. Of this total reduction, manure storage upgrades will account for 31.6%, elimination of improper manure spreading 17.2%, improvements to pasture and access 28% and proper milkhouse waste disposal 7.6%.

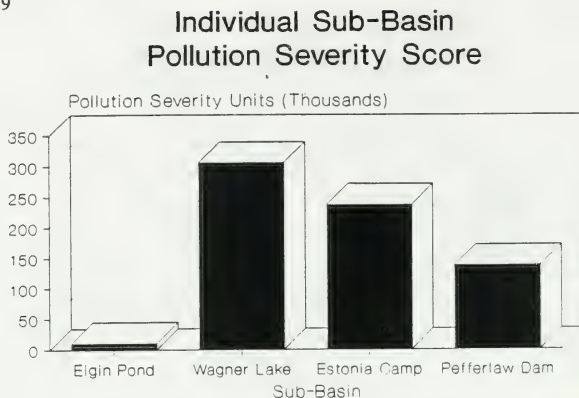
The cost required to reduce the pollution severity score as described above totals \$175,177. The total cost of manure storage is \$164,221, greater than all the cost of all the other measures combined. The cost to eliminate pasture runoff, livestock access, and discharge from milkhouse waste systems combines to account for the remaining 6.3% or \$10,965.

5.6 SUMMARY

A total of 69 livestock operations were surveyed in the Pefferlaw Brook watershed using the pollution severity ranking system. The total pollution severity score was estimated to be approximately 704,742 units. Figure 5.9 compares the distribution of the pollution severity score for the four sub-basins in the Pefferlaw Brook.

The Pefferlaw Dam sub-basin recorded the highest pollution severity score at 35.7% with only 16 farms recorded. Estonia Camp sub-basin had the largest number of farms reporting 28, and recorded the next highest score reporting 31.6% of the total. Wagner Lake sub-basin scored slightly less than the Estonia Camp sub-basin, accounting for 31.3%. Elgin Pond sub-basin is by far the smallest of the four comprised of three farms

Figure 5.9



contributing the remaining 1.4%. It has been estimated that the total pollution severity score can be reduced by approximately 84.5% or 633,911 units. This reduction can be achieved through the initiation of suggested remedial measures and education of the farm community to better manage livestock wastes.

Figure 5.10 depicts the potential reductions in the pollution severity score for each of the four sub-basins of the Pefferlaw Brook. Most of the total reduction attainable can be achieved in the Pefferlaw Dam sub-basin (35.8% or 227,213 units). Further reductions of 31.6% (200,243 units) and 31.1% (196,868 units) can be obtained in the Estonia Camp and Wagner Lake sub-basins, with the Elgin Pond sub-basin accounting for the remaining 1.5% (9,587 units).

The cost of remedial measures required to achieve the 86% reduction in the pollution severity score for the Pefferlaw Brook has been estimated at approximately \$639,846. A breakdown of the costs per sub-basin is shown in Figure 5.11. The remediation costs per sub-basin include 233,516 (35.9%) for the Estonia Camp sub-basin, an additional \$223,595 (35.9% of the total cost) the Wagner Lake sub-basin and \$175,177 (26.9% of the total cost) for the Pefferlaw Dam sub-basin. Only 1.3% of the total cost (\$7,558) is required to complete projects in the Elgin Pond sub-basin.

The farm source assessment has served to provide an information overview of the pollution source regions, pollution severity, score reductions and costs in the Pefferlaw Brook drainage basin. The following chapter will discuss in detail the required farm remediation and priority in which they should be considered.

Figure 5.10

Sub-Basin Reductions In Pollution Severity Score

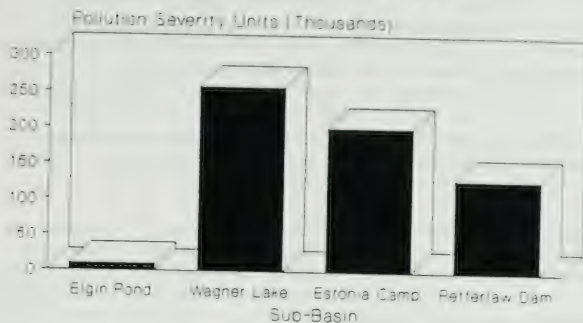
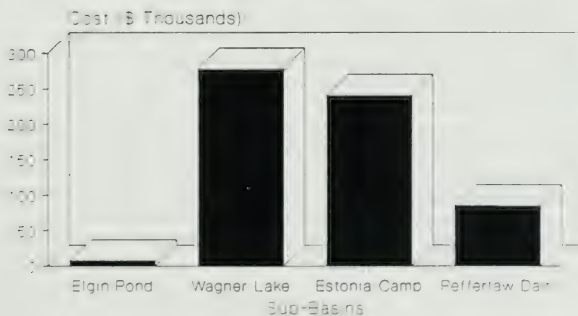


Figure 5.11

Cost Of Remedial Measures For Each Sub-Basin *



• Total Cost \$611,533

6.0 CLEAN UP RURAL BEACHES REMEDIAL PLAN

The purpose of the Clean Up Rural Beaches (CURB) Remedial Plan is to provide a framework for the implementation of proposed remedial works. Significant reductions in the total pollution severity scores of problem beach areas can be achieved through the initiation of selected remedial measures. Each of the proposed remedial measures have been examined in terms of the relative reduction in pollution severity score, cost involved, and ease of implementation. From this has evolved a scheduling of remediation works into Priority A and Priority B projects. These divisions, in addition to the beach ranking methodology, allow the formulation of a remedial management plan which can best achieve the objectives of the Lake Simcoe Rural Beaches Impact Study.

6.1 Proposed Remedial Measures for Priority A Projects

Remedial measures associated with Priority A Projects include restricting livestock access to surface waters and controlling the discharge of milkhouse wash water. These forms of remediation are; a) the most significant in improving water quality, b) most cost effective, recording the lowest cost per unit reduction ratios, and c) the most acceptable to the farm community requiring only modest capital expenditures. As a result, funding allocated towards the implementation of the CURB Remedial Plan would best be spent addressing these farm practices.

Livestock Access

Allowing livestock access to rivers and streams has been a convenient means of water livestock, however, feces and urine produced can be discharged directly to surface waters contributing to bacterial and nutrient contamination. In addition to bacterial contamination, livestock access contributes to other stream degradation problems including streambank erosion, stream siltation and loss of aquatic habitat.

Suggested remedial measures include the total restriction of livestock from the stream or ditch using page-wire, high tension, or electric fence. Often the stream or ditch divides a pasture, in these instances fence must be installed on both sides and an appropriate above water crossing constructed. Fencing should be kept a moderate distance away from the stream or ditch so that vegetation can be established to produce a buffer strip which will reduce fecal contamination from pasture runoff. The planting of shrubs and trees within the buffer zone is encouraged as it will stabilize the streambank and provide shade to enhance the aquatic ecosystem. Alternate water facilities for livestock are necessary. A number of techniques can be employed to provide water to livestock utilizing surface water or ground water from existing wells.

Milkhouse Wastewater

Tile effluent contaminated by milkhouse wash water has been found to contain high concentrations of bacteria. Preliminary evidence indicates that the tile drains provide an environment conducive to bacteria growth (UTRCA, 1987). Livestock watering downstream of drain outlets are potentially exposed to a greater range of pathogenic organisms which can influence herd health, and cost farmers through reduced productivity and veterinarian bills. In addition to bacteria, wash water also contains high concentrations of phosphorus which promotes the growth of algae and aquatic plants.

Suggested remedial measures include the treatment of milkhouse wash water using existing manure storage system, the construction of a milkhouse wash water holding tank and/or treatment trench. If wash water is to be rerouted to a manure storage it should be checked to ensure that the storage has the capacity to handle the additional daily waste input. The utilization of treatment trenches is another popular method of controlling milkhouse wash water, however this technique is provisional on existing soil and drainage conditions and should not be employed in heavy poorly drained soils. Holding tanks can be used regardless of the soil or drainage conditions, but, like manure storage require a large amount of maintenance.

6.2 Proposed Remedial Measures for Priority B Projects

Remedial measures associated with Priority B Projects includes construction of approved 200 day manure storages, capable of storing manure waste, rainwater and runoff generated from feedlots during that time period. The construction of these remedial measures generally do less for improving water quality than Priority A Projects since surface water contamination only occurs when a rainfall or snowmelt events produce the runoff necessary to transport bacteria. Subsequently, Priority B farms are less significant contributors to bacterial contamination and should be addressed only after Priority A Projects have been completed. Implementation of Priority B Projects will be limited since construction of manure storage and runoff collection devices are not widely accepted within the farm community due to the high cost involved and present economical environment.

Manure Storage and Feedlots

Manure storage systems consist of a cement pad with retaining walls for solid wastes and either a cement covered tank, cement tank, or clay lined pit to collect liquid waste and runoff. Feedlots can be incorporated into these systems however runoff devices must be sized accordingly in relation to the feedlot surface area to provide a minimum of 200 days accumulation. Manure storage systems are costly requiring large capital investments along with some maintenance, but it should be stressed to farmers that there are commercial benefits besides those dealing strictly with pollution. For example, the fertilizer value of stored manure is greater than when nutrients are lost to runoff water. Also, proper timing of manure spreading ensures that the manure is fully utilized.

Manure Spreading Practices

Promotion of acceptable manure spreading practices were considered within the framework of the CURB Remedial Plan as a Priority B Project. No attempts were made to estimate costs associated with correcting improper manure spreading practices (spreading to close to a stream or ditch, not incorporating manure after surface application, and winter spreading). Changing these practices does not involve a cost to the farm operator with the exception of manure over-application and winter spreading necessitated by inadequate storage. In these cases, the change in the reduction farm score from improved manure application is included in the reduction associated with manure storage.

6.3 Selection of Remedial Measures

Using the Pollution Severity Ranking System (see chapter 3.0) manure storage and management practices for individual livestock operations were assessed along with the estimated reductions obtainable through the initiation of remedial measures. Costs associated with each remedial measure were also determined and used to calculate the cost per unit reduction in the pollution severity score. Referred to as the Delta/Cost Ratio, this assessment procedure has provided a means for ordering the remedial measures within their Priority A or B designation to ensure the greatest reduction in fecal pollution for the least amount of capital expenditure. Where several remedial measures have been proposed for a single farm practice (ie. manure storage), the most cost effective has been selected.

As might be expected, not all landowners agree with proposed remediation, or are in a position to participate in a program of improved manure management benefiting regional water quality. For this reason the use of the delta/cost ratio can not always be adhered to. As a result it becomes probable that less cost effective projects may be undertaken in response to landowner interest and ability to meet the requirements of the financing programs. Under these circumstances the beach ranking methodology will be used to determine the order of project completion for works with a less effective delta/cost ratio. This will allow recreationally significant beach area to receive priority attention in the form of water quality remedial works.

6.3.1 Elgin Pond Priority A Projects

There are a total of three Priority A projects within the Elgin Pond sub-basin. Completing these projects would yield a total reduction of 5,791 pollution units and would cost a total of \$1,310. All of the projects involve fencing work and or pasture modifications. Table 6.0 summarizes the reduction, cost and delta cost associated with the remedial work needed for each individual farm.

Table 6.0

Priority "A" Projects
Elgin Pond

Farm #	Practice	Reduction	Cost	Delta Cost
U710	Pasture	1950	0	0.00
U712	Pasture	3821	1238	0.30
U616	Pasture	20	72	3.60
n=3	Total	5791	1310	

6.3.2 Elgin Pond Priority B Projects

There are two Priority B projects within the Elgin Pond sub-basin. Completion of these projects would yield a total reduction of 2,612 pollution units at a total cost of \$6248. Both projects involve improvements to manure storage practices. Table 6.1 summarizes the respective reduction, cost and delta cost associated with the remedial work necessary for each individual farm.

Table 6.1

Priority "B" Projects
Elgin Pond

Farm #	Practice	Reduction	Cost	Delta Cost
U616	Storage	40	0	0.00
U712	Storage	2572	6248	2.40
n=2	Total	2612	6248	

6.3.3 Wagner Lake Priority A Projects

Within the Wagner Lake sub-basin there are 14 farms representing Priority A projects. If all projects were completed a reduction of 93,208 pollution units could be achieved at

a total cost of \$10,157. These projects involve fencing, pasturing modifications and improvements to the handling of milkhouse wastes. Table 6.2 outlines the respective achievable reduction, cost and delta cost associated with the remedial work required for each individual farm.

Table 6.2

Priority "A" Projects
Wagner Lake

Farm #	Practice	Reduction	Cost	Delta Cost
U627	Pasture	3510	0	0.00
	Milkhouse	3256	0	0.00
S705	Pasture	2958	0	0.00
U621	Pasture	2246	0	0.00
U533	Pasture	1723	0	0.00
U620	Pasture	944	0	0.00
S605	Pasture	17120	131	0.01
S717	Pasture	8362	66	0.01
S628	Pasture	4558	328	0.07
U618	Pasture	560	52	0.09
U614	Pasture	18000	3000	0.17
S703	Milkhouse	14400	3000	0.21
S604	Milkhouse	9841	300	0.3
U529	Pasture	4160	1312	0.34
U623	Pasture	1560	1968	1.20
n=14	Total	93208	10157	

6.3.4 Wagner Lake Priority B Projects

A total of 21 farms in the Wagner Lake sub-basin are classified as Priority B projects. If all requested remedial work is completed a total reduction of 77,096 pollution units can be achieved at total cost of \$213,438. All these projects involve improvements to manure storage practices. Table 6.3 summarizes the respective reduction, cost and delta cost associated with the remedial work required for each individual farm.

Table 6.3

Priority "B" Projects
Wagner Lake

Farm #	Practice	Reduction	Cost	Delta Cost
U621	Storage	5916	2035	0.34
U629	Storage	8580	3071	0.36
U620	Storage	3480	1731	0.50
U612	Storage	2204	1187	0.54
U718	Storage	13616	7530	0.55
S701	Storage	4440	3402	0.77
U618	Storage	2284	2511	1.10
S717	Storage	6420	15874	2.40
S604	Storage	2970	8683	2.90
U533	Storage	4160	13104	3.10
U529	Storage	1560	5370	3.40
S605	Storage	1888	7530	3.90
U607	Storage	1890	6240	4.00
S718	Storage	2145	8795	4.10
U623	Storage	975	4199	4.30
S601	Storage	3600	21562	5.90
S703	Storage	2880	17460	6.00
S628	Storage	1664	10442	6.20
U627	Storage	3600	23722	6.50
U614	Storage	224	3000	13.30
S719	Storage	2600	45990	17.60
n=21	Total	77096	213438	

6.3.5 Estonia Camp Priority A Projects

Priority A projects for the Estonia Camp sub-basin consider pasture modifications at 10 livestock operations. These farms require both improvements to existing fencing, the addition of livestock stream crossings and the installation of new alternate watering facilities. The completion of the suggested remedial works would reduce the pollution severity score by an estimated 72,005 units. The associated cost would amount to \$4,001 (Figure 6.4).

Table 6.4

Priority "A" Projects
Estonia Camp

Farm #	Practice	Reduction	Cost	Delta Cost
U112	Pasture	18200	33	0.00
U415	Pasture	1810	0	0.00
U305	Pasture	1300	0	0.00
S437	Pasture	257	0	0.00
S217	Pasture	129	0	0.00
U224	Pasture	87	0	0.00
S436	Pasture	40	0	0.00
U324	Pasture	28	0	0.00
S530	Pasture	47034	2656	0.06
U217	Pasture	3120	1312	0.40
n=10	Total	72005	4001	

6.3.6 Estonia Camp Priority B Projects

The Estonia Camp sub-basin has the largest number of Priority B projects of all the Pepperlaw Brook sub-basins. There are 26 farms which require some form of manure storage upgrade or the construction of a new facility. The completion of these individual projects would allow the reduction of the pollution severity score by 85,198 units. It is not surprising that with this many farms, Estonia Camp sub-basin also represents the most expensive Priority B remediation cost of \$229,515. It is noted that some of the Delta/Cost ratio figures indicate expensive projects with only marginal reductions in the total pollution severity score. Table 6.5 summarizes the priority B projects.

Table 6.5

Priority "B" Projects
Estonia Camp

Farm #	Practice	Reduction	Cost	Delta Cost
U414	Storage	60	0	0.00
U305	Storage	2096	1731	0.80
U415	Storage	4260	4404	1.00
S309	Storage	11775	13261	1.10
S601	Storage	5580	8282	1.40
S426	Storage	6640	11414	1.70
S308	Storage	6560	13104	2.00
S530	Storage	18720	40234	2.10
U108	Storage	2600	8931	3.40
U112	Storage	6285	22471	3.50
S415	Storage	9720	34097	3.60
S420	Storage	2520	9835	3.90
U217	Storage	1170	4630	3.90
U657	Storage	2970	12743	4.20
S303	Storage	784	354	4.50
S308	Storage	650	3107	4.70
S437	Storage	650	3107	4.70
U316	Storage	796	4404	5.50
S217	Storage	260	1731	6.60
S304	Storage	320	3000	13.00
S436	Storage	140	3000	21.40
U324	Storage	98	3000	30.60
S310	Storage	240	8931	37.20
U224	Storage	184	7530	40.90
S439	Storage	60	3107	51.70
U314	Storage	60	3107	51.70
n=26	Total	85198	229515	

6.3.7 Pefferlaw Dam and Port Bolster Priority A Projects

In the Pefferlaw Dam sub-basin, there are 9 farm operations requiring Priority A remedial projects. All of these projects involve modifications to livestock pasturing techniques and watering methods. The benefits achievable through remedial work would reduce the pollution severity score by 80,019 units. The cost of the Priority A projects total \$10,956. Two of the farms, B1105 and S406 had no associated project costs (Figure 6.6).

Table 6.6

Priority "A" Projects Pefferlaw Dam and Port Bolster

Farm #	Practice	Reduction	Cost	Delta Cost
B1105	Pasture	6380	0	0.00
S406	Pasture	2500	0	0.00
S632	Pasture	13179	656	0.05
S405	Pasture	12095	965	0.08
S636	Pasture	780	66	0.08
S637	Pasture	21773	2669	0.10
S414	Pasture	15240	3200	0.20
B1204	Pasture	5688	1700	0.30
B1203	Pasture	2384	1700	0.70
n=9	Total	80019	10956	

6.3.8 Pefferlaw Dam and Port Bolster Priority B Projects

Within this sub-basin there are 15 Priority B remedial projects. These proposed projects will eliminate 67,704 pollution severity units from surface water impacting on downstream beaches. All of these projects are targeted at improving and/or constructing adequate 200 day manure storage facilities. The cost of the Priority B projects is tallied at \$164,221, the third most expensive of sub-basin in the priority B division.

Table 6.7

Priority "B" Projects
Pefferlaw Dam and Port Bolster

Farm #	Practice	Reduction	Cost	Delta Cost
B1105	Storage	12760	9835	0.70
S634	Storage	6080	6198	1.00
S511	Storage	9600	13000	1.30
S414	Storage	5715	8385	1.40
S406	Storage	2700	4659	1.70
S405	Storage	6048	20122	3.30
S632	Storage	5256	18034	3.40
B1204	Storage	2744	9835	3.40
B1003	Storage	3900	13895	3.50
B902	Storage	4320	16055	3.70
S411	Storage	2160	8930	4.10
S637	Storage	4320	22669	5.20
S512	Storage	975	5119	5.20
B1206	Storage	894	5450	6.10
S636	Storage	312	2035	6.50
n=15	Total	67704	164221	

6.4 Manure Spreading Control and Management

As a source of enteric bacteria, manure spreading can pose a significant hazard to surface water quality. Fecal coliform bacteria can easily be carried in overland flow during a precipitation event, surface runoff over frozen land and in snowmelt. Restrictions governing the time of manure application and the distance it is spread from a watercourse are solutions to the associated pollution problem. As such, it might be expected that a manure spreading management program would be determined as a first priority endeavour. Yet manure spreading was not previously included in the priority organization of manure management practices. The reasons for this are as follows. First, as a manure management practice, the solution to manure spreading leading to aquatic pollution would include a no cost education program of promoting environmentally safe manure application. As a no cost incentive, it does not require a ranking within the framework of priority cash allocation. In addition, the cause of poor spreading practices, particularly during winter months, often hinges on inadequate manure storage facilities. If, for

example, a farm operation does not have sufficient storage capacity to collect the animal waste it produces, an alternate means of disposal is required. The common solution is to spread regardless of season or field conditions.

A conflict arises on how manure spreading, as a management practice, should be designated with regard to the overall CURB plan implementation. As demonstrated above it can either be a problem involving a no cost solution, or one which is indicative of a much larger, and very expensive, manure storage problem. It is suggested that to improve this management practice, that an individual farm evaluation be preformed to determine the cause of the manure spreading concern. In cases where proper manure spreading technique is in question, then farmer education can be used to inform the farm operator of the benefits of proper manure spreading. If, however, the problem lies in an under-sized manure storage facility, then a system upgrade will be necessary. In this circumstance the project would be classified as a Priority B project due to the high expense of designing and installing an appropriate replacement manure storage system.

Unfortunately, no system of enforcement is available to regulate manure spreading activities, nor is there a strategy to oversee the continuation of suggested remedial practices. This increases the demand on the successful use of education to inform farmers of the necessity to manage their farm operation as an efficient business which is also environmentally conscious.

6.5 Implementation Responsibilities and Funding Mechanism

Reducing agricultural pollution is ultimately the responsibility of the farmer, however, recognizing the present economic environment it is unlikely that operators will be able to initiate the suggested remedial measures without financial assistance. In addition, when assessing the contribution of the farmer to the community and the overall benefits to be achieved, a moral question exists that being should the farmer be responsible for the total cost of remediation.

If serious action is to be taken to initiate the Pefferlaw Brook CURB Remedial Plan a government assistance program is required. The Lake Simcoe Conservation Authority could provide an excellent vehicle in which to deliver the program to the farm community, however, under present funding restraints diffuse source pollution control programs are not considered core programs and as such are not funded. Therefore, some source of funding is required, both for staffing and for the initiation of projects in the field.

Future financing programs would likely involve a cost sharing approach which would aid the farmer and insure the continued vigilance in project maintenance. A cost sharing ratio of 75% assistance and 25% landowner contribution may be sufficient to entice a reasonable level of participation in a program aimed at improving the regional water quality. As an assistance program using public funding, it should be noted that the advantage of reducing the pollution in the aquatic environment benefits proportionately a large number of people.

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APPENDIX: A

CRITERIA FOR BEACH CLOSURE (AS SET BY LOCAL HEALTH UNITS)

York Region Health Unit:

This health unit begins sampling June 1, and continues to September 1. Their sampling methodology requires that five samples be taken once per week. If the five samples exhibit fecal coliforms above 100 per 100 ml then the beach is closed. For the beach to be re-opened, five samples must show bacteria counts below 100 per 100 ml during one week.

Durham Region Health Unit:

The Durham Region Health Unit samples from June to September, taking samples twice a week. Ten individual samples are taken during each sample run. If all twenty samples exceed 100 fecal coliforms per 100 ml the beach is posted. To re-open the beach, one full week of samples (20 samples) must be below 100 bacteria per 100 ml.

APPENDIX: B

METHODOLOGY OF CALCULATING BEACH CARRYING CAPACITY

Beach carrying capacity was a critical factor in evaluating the overall beach value as a recreational resource, not only for use by the public, but also in terms of economic benefit to the local service industry. The procedure of estimating beach capacity used a space standard for the number of people per unit of length of beach. This was done on the basis of a matrix of wet beach and dry beach width categories (Ministry of the Environment, 1987). The beach carrying capacity matrix for various wet and dry beach widths is listed below.

People per front metre of beach*:

wet beach	dry beach width (m)					
width (m)	<5	5-10	10-20	20-40	40-80	>80
<5	0.56	1.31	1.31	1.31	1.31	1.31
5-10**	0.56	1.77	3.51	4.10	4.10	4.10
10-20	0.56	1.77	3.51	7.02	8.20	8.20
20-40	0.56	1.77	3.51	7.02	13.35	16.40
40-80	0.56	1.77	3.51	7.02	13.35	17.59
>80	0.56	1.77	3.51	7.02	13.35	17.59

* From M.O.E., 1987.

** all beaches surveyed had at least 5-10 metres wet beach.

APPENDIX: C

METHODOLOGY OF BEACH RANKING

For the purpose of the Beach Ranking Methodology, a beach is defined as a strip of shoreline with the physiographic, climatic, access, and ownership attributes necessary to accommodate both contact and non-contact recreational activities associated with a waterfront. Certain criteria have been set-out to evaluate a beach site as to its suitability as a recreational resource. These criteria were first defined in the Ministry Of The Environments "Beach Use and Environmental Quality in Ontario" (1987) handbook and have since been modified for use in this report. The criteria have been divided into three determinant sections, namely; aquatic, physiographic, development and management. Listed below are the score values appointed to each of the individual characteristics. These factors were evaluated for each beach during the summer months of 1988. The scored results lead to the rank ordering of the beaches from high (best), to low (worst) as previously listed in Chapter 3.

Aquatic Determinants

Determinants	Rating	Score
Colour, Weeds,	1	0
Odour, Algae,	2	2
Oil Scum, Debris	3	5
	4	10
	5	15

Physiographic Determinants

Carrying Capacity (Beach Width/Beach Length)	#People	Score
	<10	1
	10-25	5
	26-50	10
	51-100	15
	101-500	25
	501-1000	35
	>1000	50

Beach Composition	Material	Score
	organic	1
	cobble	5
	gravel	10
	sand/gravel/cobble	15
	sand	25

Bottom Composition	Material	Score
	organic	1
	cobble	5
	gravel	10
	sand/gravel/cobble	15
	sand	25

Development and Management Determinants

Parking	Lot Size	Score
	0	0
	1-25	5
	26-50	10
	51-100	15
	>100	20

Admission	Cost	Score
	>\$7	1
	\$4-\$7	2
	\$1-\$3	5
	0	10

Washrooms	Present	Score
	No	0
	Yes	10

Picnic Areas	Present	Score
	No	0
	Yes	10

Variety Stores	Present	Score
	No	0
	Yes	10

APPENDIX: D

FARM SURVEY SHEET

***** Size of Operation *****

Animal	Number	Comments
Beef	_____	
Dairy	_____	
Pigs	_____	
Sheep	_____	
Horses	_____	
Poultry	_____	

***** Manure Storage *****

Types of storage systems:

_____	Concrete Pad
_____	Concrete Pad
_____	Covered
_____	Submerged
_____	Pit
_____	Covered
_____	Brickade
_____	Brickade
_____	Brickade

Manure is stored: Under eaves
At least 10' from building
In a separate building

Distance from watercourse _____ m.

Transport method: storage to market and/or sale

Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic
Soil texture: % Sand, % Clay, % Silt, % Organic

***** Manure Storage *****

Manure is stored:

_____ Septic tank and tile bed
_____ Holding tank
_____ Manure storage system
_____ Tile drain

***** Pasture *****

_____ () Direct access to watercourse
 _____ m. along _____ (side(s) of the stream above) stream

Number of Animals in Pasture:

_____ Beef
 _____ Dairy
 _____ Horses
 _____ Sheep
 _____ Pigs

Distance from watercourse _____ m.

Transport factors: pasture to receiving waters

Soil Texture	% Soil Cover	% Slope	Slope Length
_____ Sand	_____	_____	_____
_____ Sandy Loam			
_____ Silty Loam			
_____ Clay Loam			
_____ Clay			
_____ Organic			

***** Application of manure *****

Field #1:

Time: Incorporated:

_____ Spring	_____ < 1 day
_____ Summer	1 < _____ < 3 days
_____ Fall	3 < _____ < 7 days
_____ Winter	7 < _____ days

Distance from watercourse _____ m.

Transport factors: field to receiving waters

Soil Texture	% Soil Cover	% Slope	Slope Length
_____ Sand	_____	_____	_____
_____ Sandy Loam			
_____ Silty Loam			
_____ Clay Loam			
_____ Clay			
_____ Organic			

